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The discrete wavelet transform: application to sea level change research

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The discrete wavelet transform (DWT) is an important tool for the analysis of geophysical signals. The properties of time and frequency localisation of the DWT provide a local decomposition of a time series both in frequency and time in terms of coefficients that are associated with a particular dyadic scale. The DWT is a natural language for scaling processes due to its built-in multiresolution structure. Furthermore handling scale invariance in the wavelet domain is particularly appealing since the DWT acts as a decorrelating transform, converting long range dependence in the time domain into short range statistical dependence in the wavelet domain. Variances of the wavelet coefficients provide a summary of the spectral density function, reproducing in the wavelet domain the power laws underlying the scaling process.

Wavelet analysis based on the maximal overlap version of the DWT has been used by the authors in sea level change studies, both from tide gauges and satellite altimetry measurements. In this talk specific applications are discussed, including denoising through thresholding in the wavelet domain of altimetry time series, multiresolution analysis, and wavelet scale-based analysis of variance to detect and estimate long range dependence.